

Leadership Research in Teaching and Learning Statistics in Chile

Pilar Iglesias

*Pontificia Universidad Católica de Chile, Facultad de Matemáticas, Departamento de Estadística
Av. Vicuña Mackenna 4860
Santiago, Chile
pliz@mat.puc.cl*

Gloria Icaza

*Universidad de Talca, Instituto de Matemática y Física
Casilla 721
Talca, Chile
gicaza@utalca.cl*

1. Introduction

Statistics as a discipline, received a big support in Chile in the mid sixties thanks to the Inter American Center for the Teaching of Statistics (Centro Interamericano de Enseñanza de la Estadística CIENES). The center offered two applied courses aimed at training government statisticians and a mathematical statistics course leading to a Master in Mathematical Statistic (Morettin et al., 1985). This center had a great influence in the development of Statistics in Chile and Latin-America during twenty-five years. One manifestation of this influence is the creation of undergraduate and postgraduate Statistics programs, as well as the creation of the Chilean Statistical Society (SOCHE) in 1978. Details about the development of Statistics in Chile can be found in Del Pino et al., 2000.

Some statistics from CIENES shows that 26% of the students from Chile were women, equivalent to the 21% of women from other countries in Latin-America (Table 1). Several women who got their M.S. in CIENES had great influence into the development of Statistics at all levels in Chile. Since 1999, Pilar Iglesias is the president of SOCHE and heads a Bayesian section. Gloria Icaza is one of the directors of SOCHE and heads a Biostatistics section.

At present, 48.6% (35 out of 72) of the SOCHE's members are women. This percentage is rather high compare to the 9.2% of women members at ISI, as reported by Carlson, 2000. But in contrast, only 10% (4 out of 40) of statisticians with Ph.D. in Chile are women.

Table 1: Number of CIENES' graduates from Chile, and other Latin-American countries, by periods, and gender.

	1963-1972	1973-1980	1980-1985	1963-1985
Chilean women	4	20	11	35
Chilean men	33	67	36	136
Other Latin-American women	13	18	8	39
Other Latin-American men	104	61	19	184
Total	154	166	74	394

Nonetheless, research in teaching Statistics is very recent in Chile. A landmark has been the Chilean educational reform in the last five years. This educational reform includes Statistics contents at the high school level (see Del Pino et al., 1996). According to this reform some governmental and scientific organisms have promoted research in teaching and learning Statistics through:

- The National Committee for Research and Technology (CONICYT) with their FONDEF and FONDECYT projects,
- The Andes Foundation with their "Talents" project, and the
- Ministry of Education with their MINEDUC project.

To put the Chilean context, and women's contributions into perspective, we start discussing briefly the evolution of teaching and learning Statistics at undergraduate and graduate level. Section 3 talks about statistical contents into high school programs and some of the methodologies used by the authors at school level. Section 4 deals with the efforts in statistics literacy.

2. Learning Statistics at the University level

As we said in the introduction, the landmark in the development of Statistics in Chile was CIENES. Several textbooks and notes were generated for CIENES' programs. We would like to mention the notes "Probabilidades" (Araujo, 1968), which has been used for several generations in the Mathematical Statistics program at CIENES.

There are several statistical textbooks in use at the Universities, but only few with editorial support. One to mention is Horacio D'Ottone's (1958) textbook for the students of the School of Administration of the University of Chile. D'Ottone's textbook covers mainly descriptive statistics with emphasis on calculations and basic problem solutions more than exploratory analysis or interpretation. Students in the emerging Statistics programs actively used this textbook.

Other known textbooks, oriented to engineering students, are "Statistical Inference" by Cid, Mora, Valenzuela (1990), and "Probability and Statistics" by Mora, Cid, Valenzuela (1996). Georgina Valenzuela is the Director of the Statistics Department at the University of Concepción. Another textbook is "Statistics: theory and methods" by Del Pino (1995). This book is oriented to statistics postgraduate students. The emphasis is in the statistical theory foundations and modeling. In Biostatistics there are two textbooks, one by Silva and Jadue (1994) and other edited by Erica Taucher (1997).

Behind books and names we would like to mention women that have been fundamental in the development of Statistics in Chile. They have been teachers in the University, many of them have occupied administrative positions, they have actively participated in SOCHE, and they also have directed M.S. and Ph.D. thesis. We would like to mention two women that have important influence from different areas. First, Erica Taucher's work for her special trajectory as a physician and statistician. She got her M.D. at University of Chile and her M.S. in 1967 from CIENES. She started teaching biostatistics at the School of Public Health of the University of Chile in 1962. Between 1968 and 1973 she taught in the first postgraduate program in biostatistics for Latin-American students. She developed this program at the School of Public Health with other colleagues that also had graduated from CIENES (Claudio Silva, Julia Jadue, and Claudio Pinto). From 1974 to 1983 she shifted towards demographic statistics at the Latin-American Center of Demography of the Economic Commission for Latin-America and the Caribbean (ECLAC). Finally between 1984 and 1999 she taught biostatistical courses to Latin-American Students and continued research at the Nutrition and Food Technology Institute (INTA) of the University of Chile. From all her notes, and those of her colleagues during her career since 1961 she edited the book "Biostatistics" (1997).

From other area we would like to mention Marisa Yadlin, M.S. in sociology; she is the first woman to get a Ph.D. in Statistics in Chile. She got her Ph.D. from the University of California at Berkeley in 1986. Marisa was the first woman to be the director of Statistics Department at Catholic University. This department is at present the only department with MS. and Ph.D. statistics programs in Chile and Pilar Iglesias is, since 2000, the director. Marisa has taught statistics courses and directed many theses to whom today are important statisticians in Chile.

Women in University of Valparaíso and Catholic University of Valparaíso have also promoted statistics career. Inés Guerrero had play an important role, she was one of the active supporter of statistics career and one of the Institute of Statistics' Director.

A debating point among the statistics community in Chile is that statistic careers in Chile, like in most of the Latin-American countries, are at the undergraduate level. Some people argued that student are not mature enough to develop a statistic mind. We think that this is a cultural matter and having more statisticians at all levels of the education will be a benefit for the country. In addition, currently there are limited opportunities for education and training at the M.S. and Ph.D. levels in Chile. The same reality was true more than a decade ago as reported by Morettin et al., 1985.

3. Teaching Statistics at School

In 1997 a discussion took place to decide statistics requirement at high school level. The Ministry of Education invited the Chilean Society of Statistics to the debate. Del Pino et al., 1996 contains SOCHE's proposal to the educational reform. In this document they proposed as a main objective to give a global idea of what statistics is to help the student to become an informed citizen. The educational authority's interest to incorporate statistics in high school has increased the interest of the statistical community to participate in research in statistics education projects. Since 1997 the Pontific Catholic University of Chile through the Math Faculty has carried out continuing education to High School Math teachers. One of the first attempts was the course "Statistical Methods" (Iglesias y Saavedra, 1997). This course is divided in two parts: Exploratory data analysis and

Probability. Another similar project propose to work with a problem that relates Statistics, Probability, and Decision-Making (Iglesias, 1997).

The University of Talca as well, has been teaching continuing education classes to Math's teachers and high school students since 1995. Since 1999 Statistics has been incorporated with great success. Challenging conceptual problems are the purpose of the high school students' workshops. In the year 2000 Martha Aliaga from the University of Michigan was invited, and Texas Instruments sponsored the workshop. The workshop's participants (high school teachers) had the opportunity to solve exploratory exercises from Aliaga's book (1999) with the graphical calculator. The inclusion of statistical contents into the high school curriculum also increases the demand of statistical workshops by private schools (Icaza, 1999).

Another line to put into practice the high school curriculum, was the workshop for secondary and high school students through an Explora-Conicyt project (Aravena, Del Pino, Iglesias, 1999, 2000) called "Randomness, Science and Society" I and II. The workshop was divided into three modules: Statistics and Media, Exploratory Analysis, and Probability. The goal in the first module was to develop common sense and critic spirit when reading information from media. Pilar Iglesias developed the second module with animated cartoons. This newly method has been proven efficient and stimulating for the students. In the second module she tries to formalize ideas from the first module. The formalization involves student's activities and presentations. The last module present simple basic ideas of probability with appealing experiments. Many ideas are illustrated using an Excel program "SIMPUC".

Other types of projects are related with the use of WEB pages and Statistics for high school teachers and students. These WEB pages contain activities, statistical concepts, exercises and animations (Silva, 2000; Galbiati, 2000; Pascual et al., 2000).

Irma Molina from the University Austral has promoted some other informal initiatives. Irma is also M.S. from CIENES and she has been an active participant in SOCHE.

The Mathematical Society of Chile (SOMACHI) and SOCHE has incorporated into their annual meetings, classes, workshops, and conferences about statistical education with IASE's and CONICYT's support. This year, 2001, our annual SOCHE's meeting will be held in October in the city of Antofagasta in the northern region of Chile. This paper's authors will lead a workshop to high school teachers.

Recently, an Education section for the SOCHE has been proposed. We hope that this initiative will be a successful and fruitful one.

4. Statistical Literacy

To develop statistical teaching oriented towards the general public is without any doubt a big challenge. Del Pino et al. (1989) mentioned: "cold numbers for the big mass are stunning new discoveries for statisticians. How can we communicate our fascination to the public?" This was the author's purpose for the book "Statistics: Understanding a World with Randomness". Del Pino and others developed a unique masterpiece that was broadcasted many times by the national open television (run by the Catholic University). This program had the participation of professional actors and directors. Del Pino and colleagues wrote the scripts and the companion book. Some secondary level of Math is required for the textbook, but the video has been successful with the general public and used in basic courses of statistics for non-math background students (e.g. Geography, Nursing, etc.). Except for this outstanding project we do not know any other initiatives in statistical literacy and we think that this is an important subject to be developed.

Conclusion

Our experience tells us that students are more open to statistical ideas than schoolteachers. The main reason probably is that math teachers did not have statistical contents in their curriculum when they got their degrees. This opened the idea of rethinking the math's teacher curriculum.

One of the big ideas of educational reform is to develop transversal activities, and statistics is by nature transversal (interdisciplinary). We are sure that statistics may provide a substantial contribution with the reform.

The workshop's evaluation shows that the students have greater difficulties with probability, even with the effort of teaching with experimentation. We found possible to learn statistics without using mathematical formulae, but we still need to elaborate the appropriate material, and this is one of our goals.

The problem of having only few women with Ph.D. in statistics in Chile is one part of the larger problem, in Chile Statistics is not yet recognized as a science. Last year a "Science-Chile

2000” meeting was organized by the Chilean Academy of Sciences and Statistics was not officially invited. The Mathematical Society of Chile invited us, but our work (see Del Pino et al., 2000) was not into the final document of the meeting (<http://www.conicyt.cl/ciencia2000/final-ciencia.pdf>). The reason for that was that the Chilean Academy of Sciences sees Statistics as a Math’s branch.

One of the areas that need attention is statistical literacy; it is very discouraging to find out in the media a very bad opinion about statistics and statisticians.

Finally, we would like to say that, thank to this opportunity, we realized that we are in fact doing some efforts for the statistical education in Chile. Also, this work will help SOCHE to structure and to support isolated initiatives.

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RESUME

Cette article a pour but la discussion des quelques methodologies qui not été employées dans certains projects de recherches concernant l’enseignement de la statistique aux instituteurs, institutrices, élèves et publique en général. Nous soulignons le rôle de la femme dans l’enseignement de la statistique aux niveau universitaire, professionnelle et secondaire.